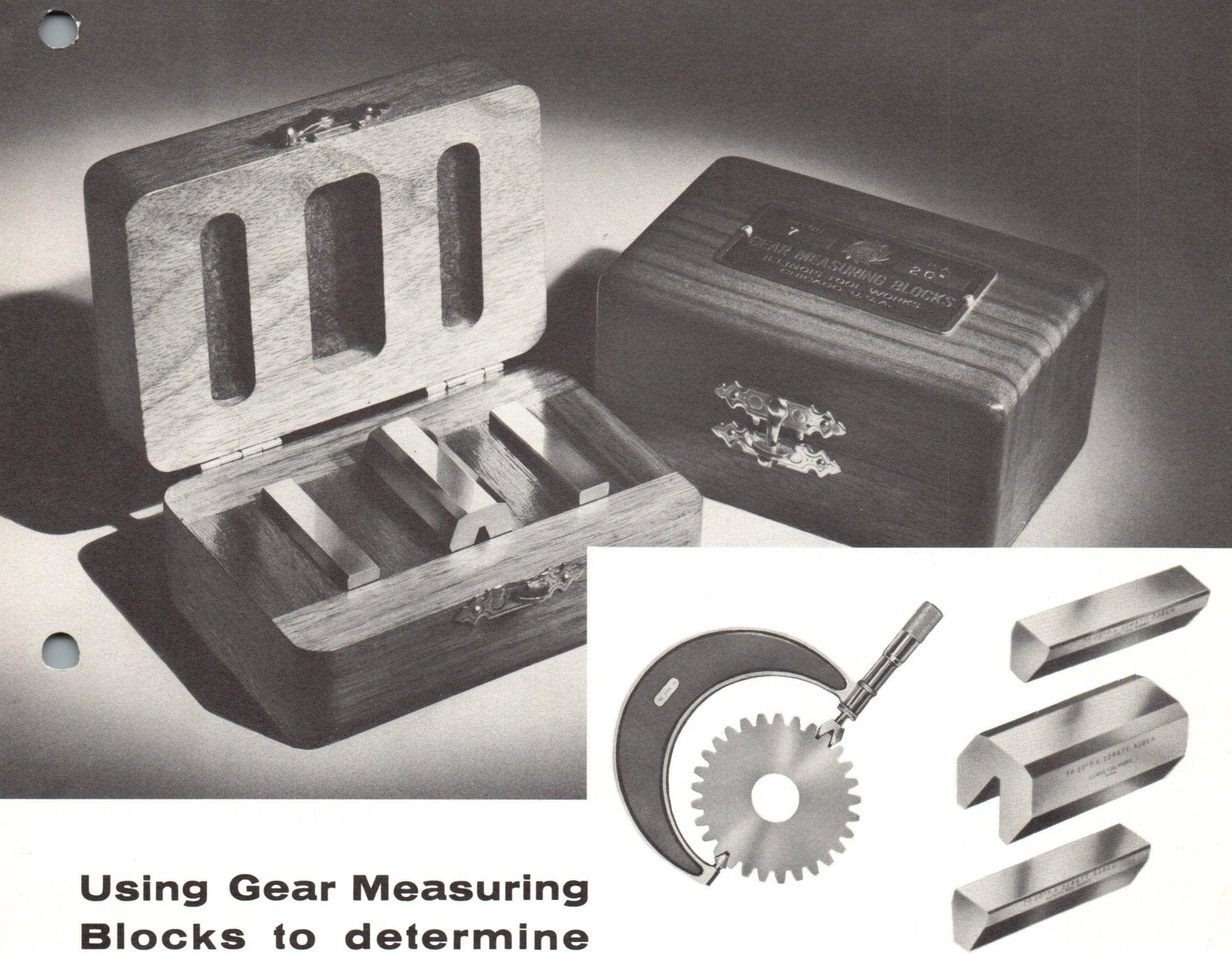
ILLINOIS TOOL WORKS
Gear Measuring Blocks



Using Gear Measuring Blocks to determine correct pitch diameter and tooth thickness

In gear cutting, the machine operator must measure the gear to determine proper depth that the cutter, hob or other gear tool must be set to secure correct pitch diameter of finished gears. Many methods such as pins, balls and wires have been devised to accomplish this measurement.

Illinois Tool Works Gear Measuring Blocks have been designed to eliminate some of the common shortcomings of these methods. The blocks are in effect theoretical rack teeth of known proportion, because they are made to exact pitch and pressure angle of the work gear.

Each set consists of three blocks, two males and one female, and is constructed for a specific pitch and pressure angle. Two male blocks are used to measure gears with an even number of teeth, and the combination of one male and one female for gears with an odd number of teeth. Special sets are made to fill specific requirements.

These blocks are machined with large flat top surfaces which provide a solid seat for the micrometer anvils, thereby assuring correct reading. All points of contact with the gear tooth lie along the line of action, thus they always check the true pitch line condition of thickness and space.

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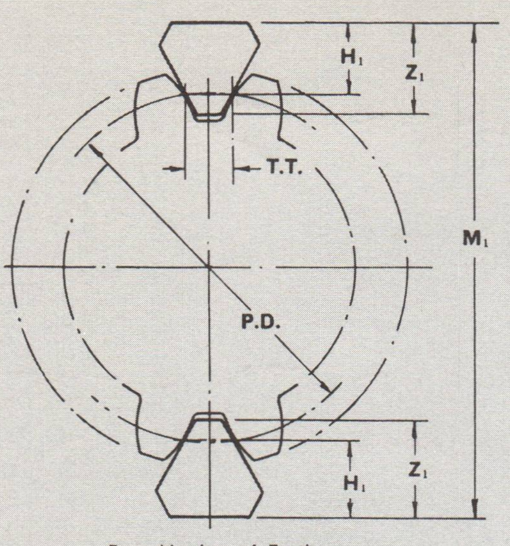
MEASURING SPUR & HELICAL GEARS



Even Number of Teeth

FORMULAE

P.D. = Pitch Diameter of Gear

$H_1 = \dfrac{1.600}{DP}$

CTT_n = Circular Tooth Thickness of Gear in Normal Plane

$T.T. = \dfrac{1.571}{DP}$

$CP = \dfrac{3.14159}{DP}$

ψ = Normal Pressure Angle of Gear

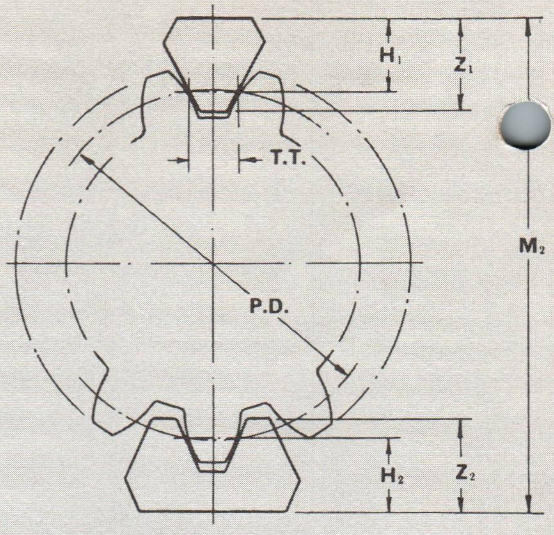
$H_2 = \dfrac{3.0}{DP}$

$Z_1 = \dfrac{2.4}{DP}$

$Z_2 = \dfrac{3.8}{DP}$

M_1 = Pitch Diameter + $2H_1$

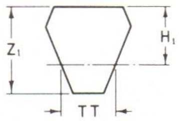
M_2 = Pitch Diameter + $H_1 + H_2$

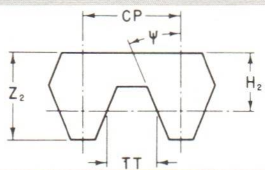


Odd Number of Teeth

NOTE: Illinois Tool Works Gear Measuring Blocks are made to order in pitches from 1 thru 48.

EXAMPLES:





Diametral Pitch	Circular Pitch	H_1	TT	Z_1	H_2	TT	Z_2
6	.5236	.2666	.2618	.4000	.5000	.2618	.6333
10	.3142	.1600	.1571	.2400	.3000	.1571	.3800

MEASURING WITH GEAR BLOCKS

The mathematical relations between block and gear are simple and easily understood. The known tooth thickness of a block is placed at a distance H from the top surface; H_1 for male blocks, H_2 for female. This tooth thickness is called TT and equals one-half of the circular pitch for which the block is made. Both TT and H are stamped on the blocks for quick identification.

In measuring a gear in which the tooth space equals one-half of the circular pitch, the dimensions over blocks would be:

For gears with an even number of teeth
Pitch Diameter + (2 times H_1)

For gears with an uneven number of teeth
Pitch Diameter + H_1 + H_2

In most cases, the tooth space is wider than one-half of the circular pitch. This is done to provide the gears with required backlash for smooth running. A wider space will consequently place the blocks further toward the center of the gear. The exact amount of this correction equals:

Normal Backlash on one side of gear tooth × Cosecant of Pressure Angle.

The measurement over blocks becomes:

For gears with an even number of teeth
M_1 = Pitch Diameter + (2 times H_1) − (Normal Backlash × Cosecant of Pressure Angle)

For gears with an odd number of teeth
M_2 = Pitch Diameter + H_1 + H_2 − (Normal Backlash × Cosecant of Pressure Angle)

TOTAL BL PER GEAR

EXAMPLE OF GEAR BLOCK MEASUREMENT

Gear Data:

6 pitch, 20° pressure angle, 24 teeth, 4.000 pitch diameter, .0025 normal backlash

Use 6 pitch male blocks: H_1 equals .2666

M_1 = 4.000 plus (2 times .2666) − (.0025 × 2.9238)

M_1 = 4.5259

For figuring tooth thickness from a reading over blocks, the equation may be reversed to:

Normal Backlash for even number of teeth = (Pitch Diameter + 2 H_1 − Reading over blocks) × Sine of Pressure Angle.

Normal Backlash for odd number of teeth = (Pitch Diameter + H_1 + H_2 − Reading over blocks) × Sine of Pressure Angle.

Actual Tooth Thickness = one-half Circular Pitch − (Normal Backlash × Secant of Pressure Angle.)

Blocks may be used for all Stub Systems of the same pitch, because there is sufficient clearance between the bottom surface of the block and root diameter of the gear.

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